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filed on 17 May 1999.

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AUSTRALIA

Patents Act 1990

Sachcom Pty Ltd

PROVISIONAL SPECIFICATION

Invention Title:

Remote temperature sensing

The invention is described in the following statement:

Remote temperature sensing

Introduction

The present invention relates generally to remote sensing and in particular, it provides a system and method of sensing parameters on a mobile vehicle over long distances via a satellite communication link.

5 Background of the Invention

When perishable goods such as fruits, vegetables, fish meat or dairy products are shipped, it is necessary to load them into a controlled environment for the journey. This is particularly the case for delivery over long distances, such as by ship, train or road transport, where goods are 10 transported in shipping containers, as it is necessary to maintain at least the temperature of the goods within acceptable limits over the duration of the journey. In some instances, humidity must also be maintained within specified limits in order to guarantee safe delivery of the goods.

In the past, refrigerated shipping containers were set up with 15 temperature recording apparatus for measuring internal temperature (and also humidity where applicable), at a point external to the container, such that an engineer could periodically monitor the temperature inside each container and act where necessary to maintain the refrigeration equipment to ensure safe passage of the goods. Unfortunately, it has often been observed, 20 at the end of such a journey, that goods in a container have spoiled because the external display has not accurately reflected the internal conditions in the containers. This in turn, leads to expenses for the insurer, the disappointment of the recipient, who does not have the benefit of the product being delivered and often, damage to the business and the reputation of the 25 supplier when the recipient resorts to other, more reliable markets.

Summary of the Invention

According to a first aspect, the present invention consists in a telemetry system for measuring one or more parameters and transmitting a signal representing the value or values of the one or more measured 30 parameters over a significant but variable distance via at least one relay transponder, the system comprising parameter measurement means to measure the respective parameters, signal generator means to generate a signal representative of the measured value for transmission and communication means for transmitting the signal via the at least one 35 transponder to a receiving station connected to a telecommunications

network and monitoring means also connected to the telecommunications network for receiving the signal and indicating if the value or any one of the values represented by the signal is outside a predetermined range.

In a first embodiment, the measurement of the one or more parameter values is performed by a stand alone data logging device which includes measurement means for measuring the parameter values, which might typically be temperature and humidity, storage means such as a digital memory or a magnetic storage device such as a floppy disk drive to record 10 the measured parameter values and control means to periodically cause the measurement to be made and recorded in the storage means. The control means also preferably includes an input/output means for receiving a trigger signal to trigger the down loading of data and in response to the trigger signal, generating an output signal representing some or all of the data held in the storage means. Preferably, the control means records the parameter values at regular intervals in the range of once per 10 minutes to once per 2 hours.

In the first embodiment, a control unit is connected to the data logger and to the transmission means and for transmission via the at least one transponder. The control unit can either be arranged to periodically download the data from the data logger and initiate a transmission automatically, or alternatively, the control unit may be arranged to respond to a signal transmitted to the communication means from the monitoring means via the at least one transponder to then unload data from the data logger and transmit it to the receiving station. In the case where the control unit periodically initiates downloading of data for transmission without prompting from the monitoring means, the control unit may also examine the data and if it is in tolerance, it may merely send a transmission indicating that the system is operating correctly and all data is in tolerance rather than sending all of the recorded data.

30 Preferably, the communication means is a transmitter arranged to transmit to a local transponder which in turn relays the signal to the receiving station via pre-existing communications channels. In the case of shipboard operation, the pre-existing communications system may include a communications channel associated with a satellite navigation system, 35 which in turn communicates with a private or public switched network. The communication means in this case, a low power transmitter which

communicates with a shipboard transponder, which in turn signals via a satellite to a ground station where interconnection with the switched network occurs.

According to a second aspect, the invention provides a remote sensing unit for a telemetry system, the remote sensing unit being arranged for mounting in a container intended for shipping on a vehicle or ship, the unit comprising:

parameter measurement means to measure a parameter or parameters of interest;

10 signal generator means to generate a signal representative of the measured value of the or each parameter; and

communication means for transmitting the signal to a transponder, located on the ship or vehicle when the container is in transit for further transmission via a communication network.

15 According to a third aspect, the invention provides a control unit arranged to be connectable to a data logger and including trigger signal generating means to trigger the data logger to download data, data input means to receive data from a connected data logger, signal generating means to generate a signal encoding the downloaded data in a format suitable for 20 transmission over a communications network and input/output means arranged for connection to a communications device for communicating the signal generated by the signal generating means to the communication device.

Brief Description of the Drawings

25 Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings in which:

Figure 1 provides a schematic overview of a communication system embodying the present invention;

30 Figure 2 is a schematic diagram of the shipboard components of a shipping container monitoring embodiment of the invention;

Figure 3 is a more detailed block schematic of the container mounted components of one embodiment of the general system illustrated in Figure 2; and

35 Figure 4 is a block diagram of an integrated module performing the same functions as the Figure 3 embodiment.

Detailed Description of the Preferred Embodiments

Referring to Figure 1, an overview of the preferred embodiment is provided, wherein the telemetry system of the present invention is associated with one or more containers 11 loaded onto a ship 10 which has a communication system associated with its satellite navigation system. The communication system transmits signals 39 from an antenna 13 on the ship 10 to an antenna 14 on a satellite 15 in orbit above the earth. The navigation system actually make use of at least 3 satellites at any one time and these are part of a network of satellites providing global coverage, but for simplicity, only one satellite is shown. The satellite then retransmits the signal either directly or indirectly to an antenna 16 of a ground station 17 where the transceiver 18 is directly or indirectly connected to a communication network 19, 20, 21, which may be a private network, a public switched network or a combination of the two. Also connected to the communications network, is a monitoring station 22 which may be a single personal computer, or may itself be a network of computers monitoring a large number of containers simultaneously.

Turning to Figure 2, a container 11, carrying a component 12 of the telemetry system is illustrated. The container is a refrigerated container in which the refrigeration unit 31 is preset to a value which it will automatically maintain throughout the journey. The refrigeration unit monitors the internal temperature of the container 11 and records it on the pie chart recorder 54 such that if the refrigeration unit 31 malfunctions and fails to maintain the correct temperature, an engineer monitoring the container on the ship, will notice the error and take the necessary corrective action. Unfortunately, sometimes the refrigeration and/or monitoring unit will malfunction in a manner which causes the recorder to continue indicating a correct internal temperature, even though the temperature is out of specification.

It has been known in the recent past, for shippers to place their own data logger in a container so that they have a record of temperatures at the end of the journey which give an indication of whether the temperature went out of specification during a trip and whether this is an explanation for spoilage of part or all of the contents of the container prior to arrival at the destination.

However, such data loggers did not correct the situation, they simply provided evidence as to what went wrong.

In the proposed telemetry system, the container mounted unit 12 transmits via its antenna 34, a signal 41 containing data indicating the status 5 of the container. This signal is received by shipboard transponder 32 including an antenna 33, a first transceiver 35 for communication with shipboard devices such as the container module 12, control unit 36 which monitors and buffers signals for retransmission and routes incoming signals, and a second transceiver 37 which transmits and receives signals 39, to and 10 from the satellite 15 via its antenna 38. Thus signals from the container mounted module 12 may be relayed via the shipboard relay 32, the satellite 17 and the communications network 19, 20, 21 to the receiver station 22.

In a first embodiment of the present invention, a prior art data logger 15 42 is incorporated into the proposed telemetry system. These units are known and understood to provide reliable measurement of the environmental parameters within a container and are therefore trusted by the shippers.

The data logger 42 will typically contain one or more parameter 20 sensors 43, such as temperature and relative humidity sensors, a memory 44 for storing parameter measurements until they are required in response to an interrogating signal and a control circuit 45 which would typically be a microprocessor programmed to periodically interrogate the sensor or sensors and to record the measured parameter values and to respond to an external interrogating signal to transmit data to an interrogating device.

A control unit 46 is connected to the data logger 42, and is preferably 25 an appropriately preprogrammed microprocessor 47 having a first input/output interface 48 for connection to the data logger 42 and a second input/output interface 49 for connection to a communication device 50. The control unit 46 periodically interrogates the data logger 42 by initiating an interrogation trigger signal via the input/output device 48 and accepting the 30 data transmitted by the data logger 42. Triggering of the downloading of data may be in response to a signal received from the monitoring station 22, or alternatively, may be initiated by preprogramming in the control unit microprocessor 47, which causes the download to be triggered at regular intervals.

When data is downloaded from the data logger 42, it would typically 35 be transmitted on to the monitoring station 22. However, it is possible in

some embodiments for the control unit 46 to examine the downloaded data and only transmit the data if the data is out of specification or if the period since the last transmission to the monitoring station 22 is greater than some predetermined period. It is also possible for the control unit 46 to only

5 transmit a status signal indicating that the parameters are within specification or outside specification, rather than sending all of the data. Some of these options depend on whether the data logger used, deletes its data when it downloads and whether it is desirable to include memory in the control unit 46 to buffer and retain downloaded data.

10 When the control unit 46 is required to transmit data or a status to the monitoring station 22, it generates an output via the second input/output device 49 which interfaces with a standard transceiver 50, provided by the company providing the satellite communication service via the satellite 15. The transceiver 50 includes an input/output circuit 51, a control unit 52 and

15 an rf modulator/demodulator circuit 53 to interface the antenna 34. The transceiver unit 50 transmits signals to and receives signals from the ship's central transceiver relay 32 via which signals can be communicated to and from the ground based monitoring station 22.

Referring to Figure 4, this provides an alternative to the arrangement of

20 Figure 3, wherein the functions of the data logger 42 control unit 46 and transceiver 50 are integrated into one unit, the integrated container module 112. The integrated container module circuit 143 which interfaces with a control circuit 147, preferably implemented as a microprocessor. A buffer memory 144 is connected to the control circuit 147, to hold the parameter

25 data at least between transmissions to the monitoring station 22 and possibly for the whole journey. An input/output device 149, is provided to generate output data signals formatted for transmission over the communications network and the formatted data signals are transmitted via a modulator/demodulator 153 and antenna 143 to the ship's relay transceiver as

30 with the Figure 3 arrangement.

It will be appreciated by persons skilled in the art that numerous variations and/or modifications may be made to the invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive.

5 Dated this seventeenth day of May 1999

SACHCOM PTY LTD
Patent Attorneys for the Applicant:

F B RICE & CO

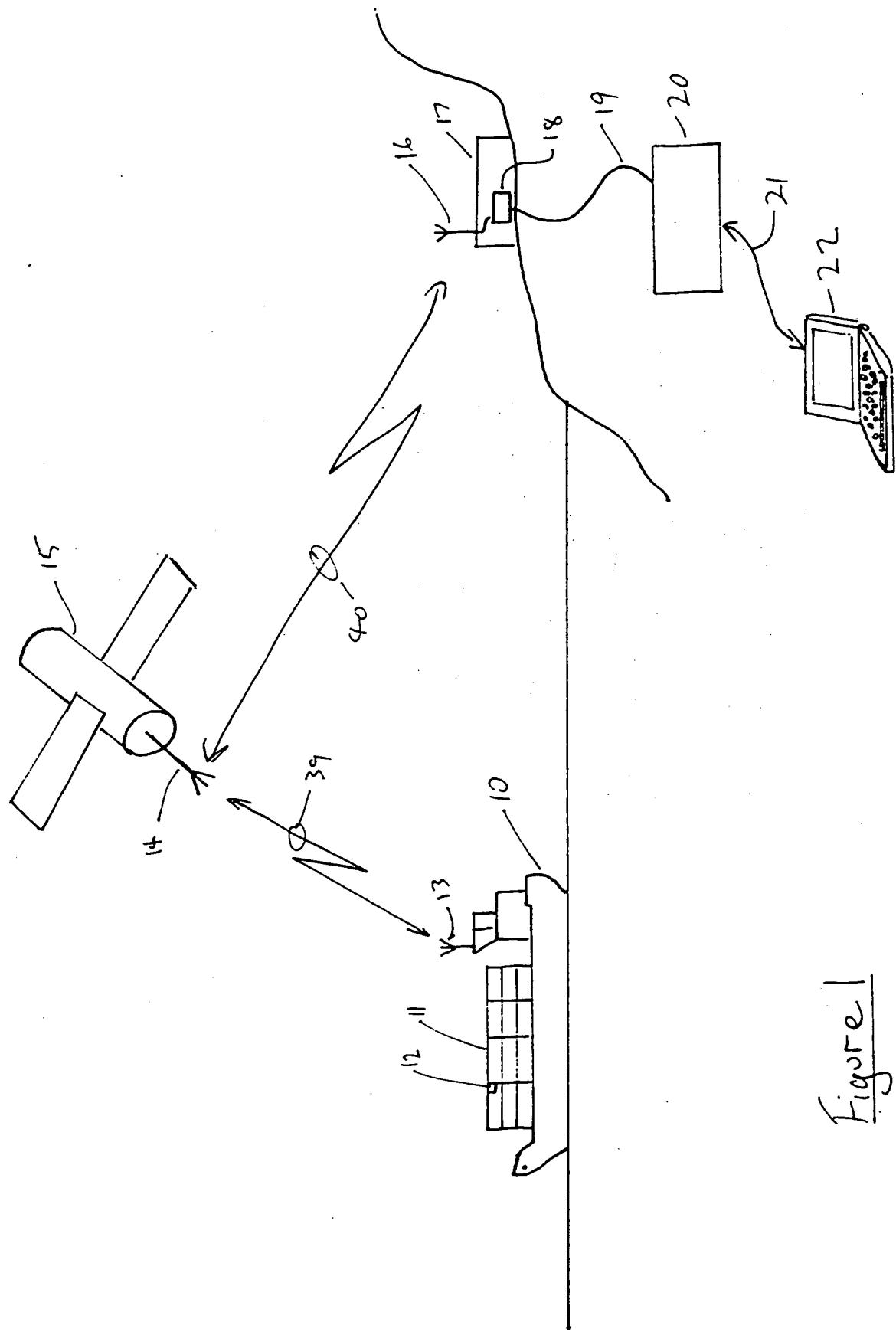


Figure 1

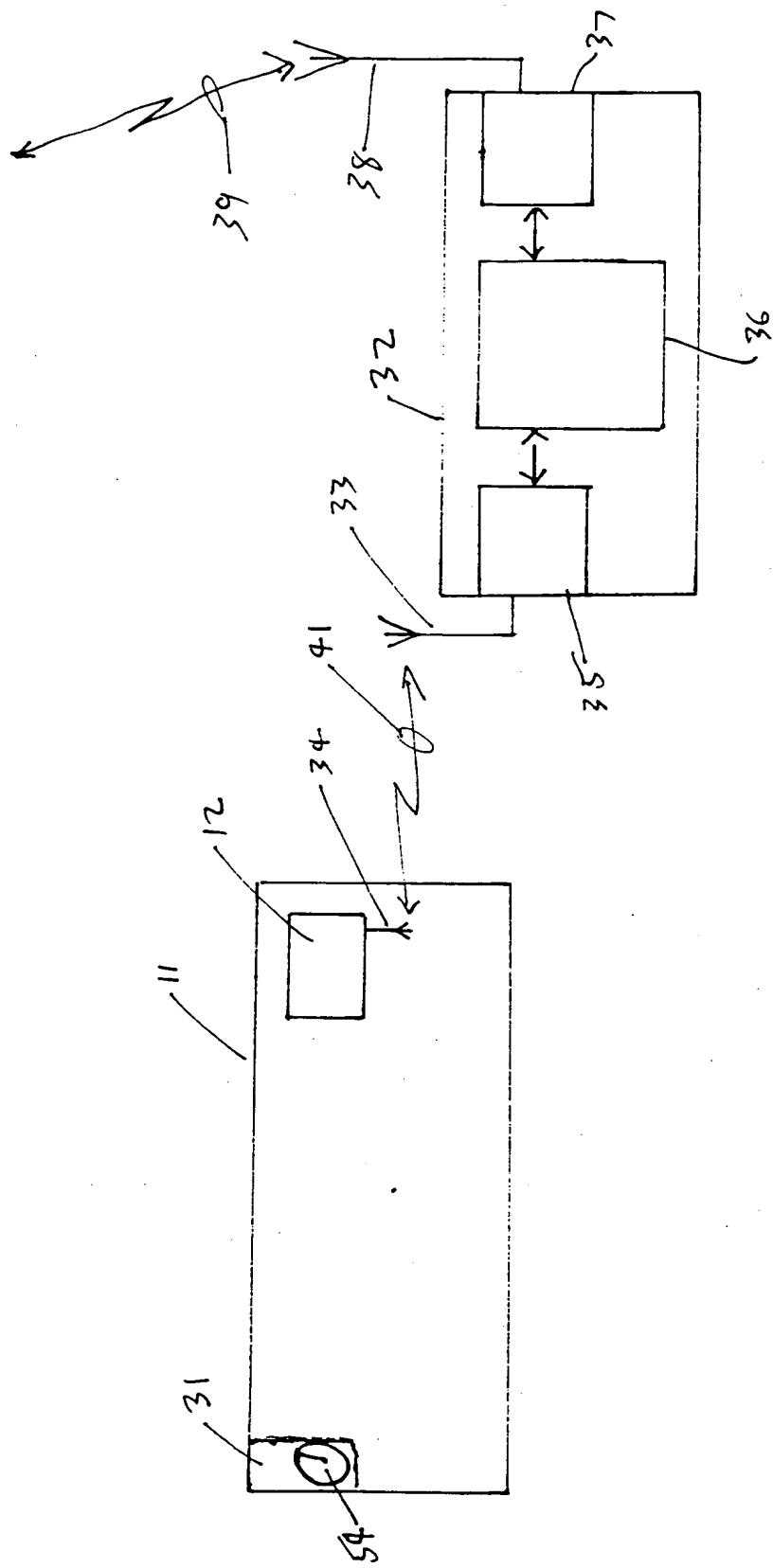


Figure 2

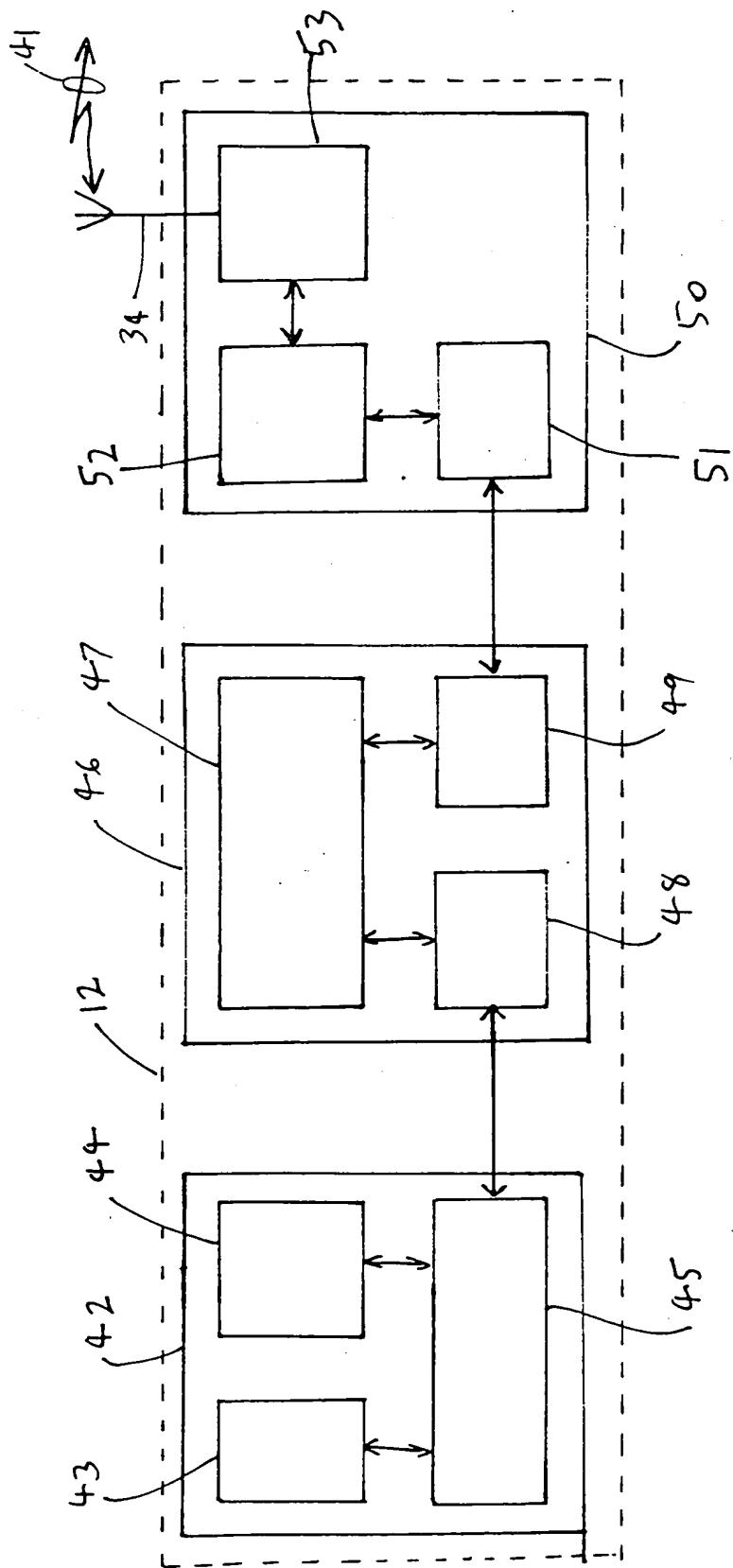


Figure 3

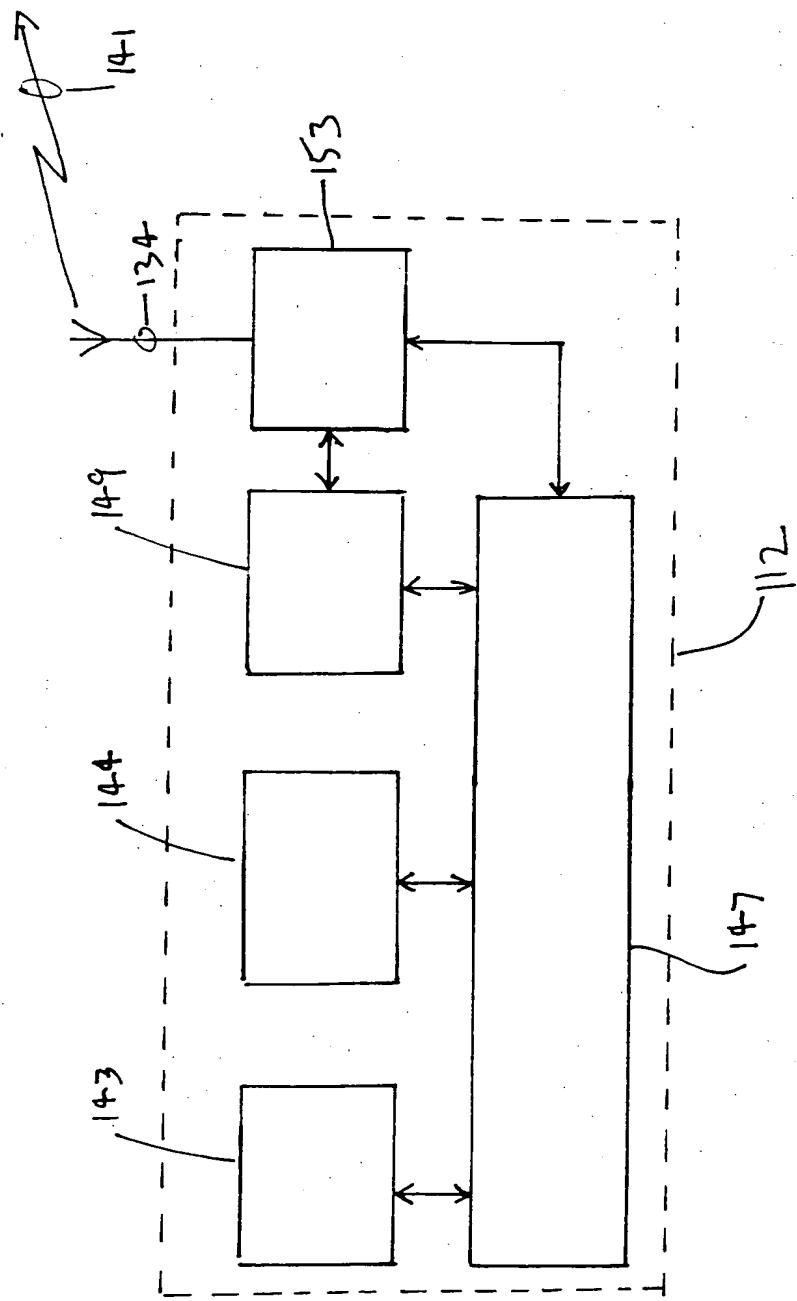


Figure 4